IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

OKUMURA et al Atty. Ref.: 1035-303

Serial No. **(to be assigned)** Group: Unknown

Filed: **Herewith** Examiner: Unknown

For: **CATALYST FOR PURIFYING EXHAUST GAS AND A PROCESS FOR PURIFYING EXHAUST GAS**

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February 7, 2001

Honorable Commissioner of Patents
Washington, DC 20231

Sir:

PRELIMINARY AMENDMENT

In order to place the above-identified application in better condition for examination, please amend the application as follows:

IN THE SPECIFICATION

Page 1, prior to "Field of the Invention" insert --This is a division of U.S. Application Serial No. 08/973,684, filed December 11, 1997, now U.S. Patent No. _____, issued _____.--

Page 3, lines 23-24, delete "Japanese Laid-Open Patent Publication No. 112488/1989 (Tokukaihei 1-112488) and insert --Japanese Laid-Open Patent Publication No. 293049/1990 (Tokukaihei 2-293049)--.

Page 40, line 20, delete "compound".

Page 51, line 2, change "barium sulfate" to --active alumina--.

Page 73, in the first column of Table 5 (corrected copy attached), "Example 30" (second occurrence) should be --Example 31--;

"Example 30" (third occurrence) should be --Example 32--;

"Example 30" (fourth occurrence) should be --Example 33--;

"Example 30" (fifth occurrence) should be --Example 34--;

"Example 30" (sixth occurrence) should be --Example 35--.

Page 75, in the first column of Table 6 (corrected copy attached), "Example 30" (second occurrence) should be --Example 31--;

"Example 30" (third occurrence) should be --Example 32--;

"Example 30" (fourth occurrence) should be --Example 33--;

"Example 30" (fifth occurrence) should be --Example 34--;

"Example 30" (sixth occurrence) should be --Example 35--.

IN THE CLAIMS:

Amend the claims as follows:

1. A catalyst for purifying exhaust gas comprising iridium and sulfur as catalyst active substances.

2. The catalyst for purifying exhaust gas as defined in claim 1, wherein iridium is deposited on a support containing sulfur.

3. The catalyst for purifying exhaust gas as defined in claim 1, wherein sulfur is provided as a sulfate.

4. A catalyst for purifying exhaust gas comprising:

a fire-resistant inorganic compound having at least one element selected from the group consisting of platinum, palladium and rhodium deposited thereon; and

a metallic sulfate having iridium deposited thereon.

10. (Amended) A catalyst for purifying exhaust gas comprising:

iridium, a rare-earth metal oxide, and sulfur; and

at least one element selected from a group consisting of calcium, strontium and barium, as catalyst active substances,

wherein the iridium forms a complex oxide with said at least one element.

11. The catalyst for purifying exhaust gas as defined in claim 10, wherein iridium forms a complex oxide with said at least one element selected from the group of said elements.

12. The catalyst for purifying exhaust gas as defined in claim 10, wherein iridium is deposited on a support containing sulfur.

13. The catalyst for purifying exhaust gas as defined in claim 10, further comprising a fire-resistant inorganic compound.

14. (Amended) A catalyst for purifying exhaust gas comprising iridium, a rare-earth metal and sulfur, and

wherein the rare-earth metal is contained as an oxide containing at least one element selected from a group consisting of cerium, lanthanum, yttrium, neodymium and praseodymium.

15. The catalyst for purifying exhaust gas as defined in claim 14, wherein the rare-earth metal is contained as an oxide containing at least one element selected from the group consisting of cerium, lanthanum, yttrium, neodymium and praseodymium.

16. (Amended) A catalyst for purifying exhaust gas comprising iridium, a rare-earth metal and sulfur, wherein the rare-earth metal is contained as a composite oxide containing at least one element selected from a group consisting of cerium, lanthanum, yttrium, neodymium and praseodymium, and at least one element selected from a group consisting of manganese, iron, cobalt, nickel, copper and zinc.

17. The catalyst for purifying exhaust gas as defined in claim 14, further comprising at least one element selected from the group consisting of tin, gallium, germanium and silicon.

18. (Amended) An exhaust-gas purifying process comprising the steps of:

preparing a catalyst for purifying exhaust gas by forming the catalyst of iridium, a rare earth metal oxide, and sulfur; and at least one element selected from a group consisting of calcium, strontium and barium, as catalyst active substances, wherein the iridium forms a complex oxide with said at least one element;

setting an exhaust-gas temperature in a range of 200°C to 700°C at an inlet to the catalyst for purifying the exhaust gas; and

directing the exhaust gas from an internal combustion engine through the catalyst for purifying the exhaust gas so as to reduce nitrogen oxides in the exhaust gas.

19. (Amended) An exhaust-gas purifying process comprising the steps of:

preparing a catalyst for purifying exhaust gas by forming the catalyst of iridium, a rare earth metal oxide, and sulfur; and at least one element selected from a group consisting of calcium, strontium and barium, as catalyst active substances, wherein the iridium forms a complex oxide with said at least one element;

setting an exhaust-gas temperature in a range of 200°C to 700°C at an inlet to the catalyst for purifying the exhaust gas; and

directing the exhaust gas from an internal combustion engine through the catalyst for purifying the exhaust gas so as to reduce hydrocarbons, carbon monoxide and nitrogen oxides in the exhaust gas from the internal combustion engine.

24. An exhaust-gas purifying process comprising the steps of:

preparing a catalyst comprising iridium, a rare-earth metal and sulfur, wherein the rare-earth metal is an oxide containing at least one element selected from a group consisting of cerium, lanthanum, yttrium, neodymium and praseodymium;

setting an exhaust-gas temperature in a range of 200°C to 700°C at an inlet to the catalyst for purifying exhaust gas; and

directing an exhaust gas from an internal combustion engine through the catalyst to purify the exhaust gas and reduce nitrogen oxides in the exhaust gas.

25. An exhaust-gas purifying process comprising the steps of:

preparing a catalyst comprising iridium, a rare-earth metal and sulfur, wherein the rare-earth metal is an oxide containing at least one element selected from a group consisting of cerium, lanthanum, yttrium, neodymium and praseodymium;

setting an exhaust-gas temperature in a range of 200°C to 700°C at an inlet to the catalyst; and

directing an exhaust gas from an internal combustion engine to pass through the catalyst for purifying exhaust gas so as to reduce hydrocarbons, carbon monoxide and nitrogen oxides in the exhaust gas from the internal combustion engine.

26. An exhaust-gas purifying process comprising the steps of:

preparing a catalyst comprising iridium, a rare-earth metal and sulfur, wherein the rare-earth metal is a composite oxide containing at least one element selected from a group consisting of cerium, lanthanum, yttrium, neodymium and praseodymium, and at least one element selected from a group consisting of manganese, iron, cobalt, nickel, copper and zinc;

setting an exhaust-gas temperature in a range of 200°C to 700°C at an inlet to the catalyst for purifying exhaust gas; and

directing an exhaust gas from an internal combustion engine through the catalyst to purify the exhaust gas and reduce nitrogen oxides in the exhaust gas.

27. An exhaust-gas purifying process comprising the steps of:

preparing a catalyst comprising iridium, a rare-earth metal and sulfur, wherein the rare-earth metal is a composite oxide containing at least one element selected

from a group consisting of cerium, lanthanum, yttrium, neodymium and praseodymium, and at least one element selected from a group consisting of manganese, iron, cobalt, nickel, copper and zinc;

setting an exhaust-gas temperature in a range of 200°C to 700°C at an inlet to the catalyst; and

directing an exhaust gas from an internal combustion engine to pass through the catalyst for purifying exhaust gas so as to reduce hydrocarbons, carbon monoxide and nitrogen oxides in the exhaust gas from the internal combustion engine.

REMARKS

Claims 1 through 4, 10 through 19 and 24 through 27 are pending in this application. The above amendments are made to place the claims in a more traditional format.

Respectfully submitted,

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IN THE CLAIMS:

Amend the claims as follows:

1. A catalyst for purifying exhaust gas comprising iridium and sulfur as catalyst active substances.

2. The catalyst for purifying exhaust gas as defined in claim 1, wherein iridium is deposited on a support containing sulfur.

3. The catalyst for purifying exhaust gas as defined in claim 1, wherein sulfur is provided as a sulfate.

4. A catalyst for purifying exhaust gas comprising:

a fire-resistant inorganic compound having at least one element selected from the group consisting of platinum, palladium and rhodium deposited thereon; and

a metallic sulfate having iridium deposited thereon.

10. (Amended) A catalyst for purifying exhaust gas comprising:

iridium, a rare-earth metal oxide, and sulfur; and

at least one element selected from [the] a group consisting of calcium, strontium and barium, as catalyst active substances,

wherein the iridium forms a complex oxide with said at least one element.

11. The catalyst for purifying exhaust gas as defined in claim 10, wherein iridium forms a complex oxide with said at least one element selected from the group of said elements.

12. The catalyst for purifying exhaust gas as defined in claim 10, wherein iridium is deposited on a support containing sulfur.

13. The catalyst for purifying exhaust gas as defined in claim 10, further comprising a fire-resistant inorganic compound.

14. (Amended) A catalyst for purifying exhaust gas comprising iridium, a rare-earth metal and sulfur, and

wherein the rare-earth metal is contained as an oxide containing at least one element selected from a group consisting of cerium, lanthanum, yttrium, neodymium and praseodymium.

15. The catalyst for purifying exhaust gas as defined in claim 14, wherein the rare-earth metal is contained as an oxide containing at least one element selected from the group consisting of cerium, lanthanum, yttrium, neodymium and praseodymium.

16. (Amended) [The] A catalyst for purifying exhaust gas [as defined in claim 14,] comprising iridium, a rare-earth metal and sulfur, wherein the rare-earth metal is contained as a composite oxide containing at least one element selected from [the] a

group consisting of cerium, lanthanum, yttrium, neodymium and praseodymium, and at least one element selected from [the] a group consisting of manganese, iron, cobalt, nickel, copper and zinc.

17. The catalyst for purifying exhaust gas as defined in claim 14, further comprising at least one element selected from the group consisting of tin, gallium, germanium and silicon.

18. (Amended) An exhaust-gas purifying process comprising the steps of:

preparing [any one of the] a catalyst[s] for purifying exhaust gas[according to claims 1 to 17] by forming the catalyst of iridium, a rare earth metal oxide, and sulfur; and at least one element selected from a group consisting of calcium, strontium and barium, as catalyst active substances, wherein the iridium forms a complex oxide with said at least one element;

setting [the] an exhaust-gas temperature in [the] a range of 200°C to 700°C at [the] an inlet [of] to the catalyst for purifying the exhaust gas; and

[allowing] directing the exhaust gas from an internal combustion engine [to pass] through the catalyst for purifying the exhaust gas so as to reduce nitrogen oxides in the exhaust gas.

19. (Amended) An exhaust-gas purifying process comprising the steps of:

preparing [any one of the] a catalyst[s] for purifying exhaust gas [according to claims 4 to 9] by forming the catalyst of iridium, a rare earth metal oxide, and sulfur; and at least one element selected from a group consisting of calcium, strontium and barium, as catalyst active substances, wherein the iridium forms a complex oxide with said at least one element;

setting [the] an exhaust-gas temperature in [the] a range of 200°C to 700°C at [the] an inlet [of] to the catalyst for purifying the exhaust gas; and

[allowing] directing the exhaust gas from an internal combustion engine [to pass] through the catalyst for purifying the exhaust gas so as to reduce hydrocarbons, carbon monoxide and nitrogen oxides in the exhaust gas from the internal combustion engine.

24. An exhaust-gas purifying process comprising the steps of:

preparing a catalyst comprising iridium, a rare-earth metal and sulfur, wherein the rare-earth metal is an oxide containing at least one element selected from a group consisting of cerium, lanthanum, yttrium, neodymium and praseodymium;

setting an exhaust-gas temperature in a range of 200°C to 700°C at an inlet to the catalyst for purifying exhaust gas; and

directing an exhaust gas from an internal combustion engine through the catalyst to purify the exhaust gas and reduce nitrogen oxides in the exhaust gas.

25. An exhaust-gas purifying process comprising the steps of:

preparing a catalyst comprising iridium, a rare-earth metal and sulfur, wherein the rare-earth metal is an oxide containing at least one element selected from a group consisting of cerium, lanthanum, yttrium, neodymium and praseodymium;

setting an exhaust-gas temperature in a range of 200°C to 700°C at an inlet to the catalyst; and

directing an exhaust gas from an internal combustion engine to pass through the catalyst for purifying exhaust gas so as to reduce hydrocarbons, carbon monoxide and nitrogen oxides in the exhaust gas from the internal combustion engine.

26. An exhaust-gas purifying process comprising the steps of:

preparing a catalyst comprising iridium, a rare-earth metal and sulfur, wherein the rare-earth metal is a composite oxide containing at least one element selected from a group consisting of cerium, lanthanum, yttrium, neodymium and praseodymium, and at least one element selected from a group consisting of manganese, iron, cobalt, nickel, copper and zinc;

setting an exhaust-gas temperature in a range of 200°C to 700°C at an inlet to the catalyst for purifying exhaust gas; and

directing an exhaust gas from an internal combustion engine through the catalyst to purify the exhaust gas and reduce nitrogen oxides in the exhaust gas.

27. An exhaust-gas purifying process comprising the steps of:

preparing a catalyst comprising iridium, a rare-earth metal and sulfur, wherein the rare-earth metal is a composite oxide containing at least one element selected from a group consisting of cerium, lanthanum, yttrium, neodymium and praseodymium, and at least one element selected from a group consisting of manganese, iron, cobalt, nickel, copper and zinc;

setting an exhaust-gas temperature in a range of 200°C to 700°C at an inlet to the catalyst; and

directing an exhaust gas from an internal combustion engine to pass through the catalyst for purifying exhaust gas so as to reduce hydrocarbons, carbon monoxide and nitrogen oxides in the exhaust gas from the internal combustion engine.

Nitrogen (N_2) the rest portion

Moreover, the results in the cases of catalyst inlet temperatures of 250 °C and 400 °C are shown in Table 5 respectively as results indicating the evaluation of the respective catalysts in the initial time (Fresh).

Table 5

	Catalysts	Purifying Rate(%) at Fresh Time at 250°C / 400°C (Catalyst Inlet Temp.) in Composition Y		
		HC	CO	NOx
Example 5	(5)	0/60	5/79	0/65
Example 30	(30)	96/96	99/99	89/91
Example ~~30~~ 31	(31)	96/96	99/99	90/91
Example ~~30~~ 32	(32)	98/98	99/99	90/92
Example ~~30~~ 33	(33)	98/98	99/99	85/88
Example ~~30~~ 34	(34)	98/98	99/99	90/91
Example ~~30~~ 35	(35)	98/98	99/99	92/96
Comp. Exam. 1	A	0/55	8/70	0/38
Comp. Exam. 2	B	0/65	7/72	0/45
Comp. Exam. 3	C	98/98	99/99	88/90
Prior Art	D	0/28	0/41	0/18

As clearly shown by the results of Table 5, it is confirmed that as compared with finished catalyst (5), comparative catalysts (A) and (B) and prior-art catalyst (D), finished catalysts (30) through (35), each of which contains an element such as platinum, can remove or reduce HC, CO and NOx more effectively with a wider temperature

Table 6

	Catalysts	Purifying Rate(%) at Aged Time at 250°C / 400°C (Catalyst Inlet Temp.) in Composition Y		
		HC	CO	NOx
Example 5	(5)	0/60	0/70	0/58
Example 30	(30)	85/91	88/95	82/87
Example 31	(31)	85/91	88/95	83/87
Example 32	(32)	86/92	87/95	84/88
Example 33	(33)	85/93	86/96	80/85
Example 34	(34)	85/91	88/96	84/87
Example 35	(35)	84/91	87/94	86/89
Comp. Exam. 1	A	0/50	0/68	0/30
Comp. Exam. 2	B	0/55	0/75	0/35
Comp. Exam. 3	C	84/90	97/95	82/88
Prior Art	D	0/15	0/20	0/5

As clearly shown by the results in Table 6, it is confirmed that as compared with comparative catalysts (A) and (B) and conventional catalyst (D), finished catalysts (30) through (35) of the present invention hardly showed any reduction in the catalyst activity due to poisoning from sulfur oxides in exhaust gas (reaction gas composition Y) even after the durability test (Aged) that had been carried out for 20 hours at 700°C of the catalyst inlet temperature, and consequently have sufficient heat-resistance and durability that are greater than those of comparative catalysts (A) through (C) and the conventional catalyst (D).